

**MUCUNA BEAN (*Mucuna spp.*) SUPPLEMENTATION OF
GROWING SHEEP FED WITH A BASAL DIET OF
NAPIER GRASS (*Pennisetum purpureum*)**

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SUMMARY

This study evaluated the effect of *Mucuna* bean as a supplement for growing Pelibuey sheep fed with a basal diet of Napier grass (*Pennisetum purpureum*). Twenty males averaging 19.9 ± 2.19 kg LW were divided in four treatment groups and fed Napier grass *ad libitum*. The *Mucuna* bean supplementation consisted of *Mucuna* bean grain and husks that had been ground into a meal. The supplementation for the four treatment groups consisted of: 300 g a⁻¹ d⁻¹ of a commercial feed (control, Co) or 5 (T5), 10 (T10), or 15 (T15) g kg LW⁻¹ d⁻¹ of *Mucuna* bean meal. The experiment lasted for 84 days and was a completely randomized design with five replications. Statistical analysis consisted of analysis of variance and orthogonal contrasts to test the control vs *Mucuna* bean supplementation and regression analysis to determine the effect of the level of *Mucuna* bean supplementation. The dry matter intake of the *Mucuna* bean meal was 148, 309 and 495 g DM a⁻¹ d⁻¹ for treatments T5, T10, and T15, respectively, while that of the control was 278 g DM a⁻¹ d⁻¹. Daily weight changes were 44, -3.4, 32 and 60 g a⁻¹ for the control and for the treatments T5, T10, and T15, respectively. There was a linear relationship between the level of *Mucuna* supplementation and the total dry matter intake (P<0.001) and the daily weight gain (P<0.01). The intake of forage was not affected by the level of *Mucuna* bean supplementation. Feeding behavior was similar among treatments. Animals eating the *Mucuna* bean did not show signs of toxicity at any of the supplementation levels.

Key words: *Mucuna* bean, sheep, dry matter intake, behavior.

INTRODUCTION

The traditional maize cultivation in the Yucatan Peninsula is based on a slash-and-burn system where land is left fallow after two to three years of cultivation (Pérez-Toro, 1981; Hernández, 1959). In the past, this "milpa" system (i.e., maize together with a number of other food crops) was able to satisfy the food needs of the population; however, the

introduction of large-scale sole-cropping of e.g., sisal (*Agave fourcroydes*) and the development of extensive cattle ranching has increased land pressure and reduced fallow periods, soil fertility and, consequently, maize production, the basic food crop not only in Yucatan but also elsewhere in Mexico (Mariaca, 1992; Ku, 1992). In order to improve the profitability of the maize-based agriculture, many smallholders keep backyard animals which also can make an important contribution to family food supply. In this context, small ruminants are particularly valuable because they can be maintained with the natural vegetation and with the by-products of the *milpa* system. Nevertheless, animal production in these systems suffers from seasonal fluctuations in forage availability (Whiteman, 1980; Crowder and Chheda, 1982; Armendáriz *et al.*, 1993) but smallholders cannot afford to buy supplements for their animals. Forage availability is particularly low during the dry season.

Mucuna bean (*Mucuna spp.*) as a green manure and cover crop in the *milpa* system has been successfully evaluated in southeastern Mexico; however, it has been suggested that increased multiple uses for the crop would foster its adoption (Arteaga *et al.*, 1997). The use of *Mucuna* bean as an animal feed (Carsky *et al.*, 1998; Eilittä and Carsky, 2001) could help to strengthen the *milpa* system both by providing extra income and by offering supplementary feeds for ruminants during the dry season.

Although it has been suggested that the *Mucuna* bean has a good nutritional value (Templeton and Gibbens, 1917; Templeton and Ferguson, 1917; Tracy and Coe, 1918; Duke, 1981; Josephine and Janardhanan, 1992; Bressani, 2000; Ayala-Burgos *et al.*, this volume), an important constraint for its wider adoption is its content of several anti-nutritional factors (Duke, 1981; Josephine and Janardhanan, 1992; Del Carmen *et al.*, 1999; Bressani, 2002). Particularly worrisome is the high content of L-Dopa, the level of which may vary even with climate and other environmental factors (St-Laurent and Capo-Chichi, unpublished). Against this background, the objective of this work was to assess the value of *Mucuna* bean as a supplement for growing sheep fed with a basal diet of a tropical forage

MATERIALS AND METHODS

The climatic conditions in the study area correspond to the AW₀ classification, with a single rainy season between May and October, an annual rainfall of 913 mm, and a mean annual temperature of 26°C (García, 1973). The soil in the central part of the Yucatan state, where this study was carried out, is predominantly stony of calcareous origin (Aguilera, 1958).

This on-farm experiment was conducted on a private farm located near Merida, Yucatan, 7 km away from the Faculty of Veterinary Medicine. The animals used for this trial were 20 growing males of the “Pelibuey” breed, with an average initial weight of 19.9 ± 2.19 kg. The animals were in pens of 9.6 m² with a metal roof and metal troughs made of half drums. Fresh water was always available in each pen. The management was carried out both by farm workers and by researchers.

Treatments consisted of four diets, with a basal component of fresh chopped Napier grass (*Pennisetum purpureum*) offered *ad libitum* to all. The daily supplementation varied by treatment, and for the control diet consisted of 300 g FM of a locally available commercial supplement (90% DM). *Mucuna* bean supplementation in the other three treatments targeted a daily supply of 5 (T5), 10 (T10) or 15 (T15) g FM (90% DM) of grain per kg LW. *Mucuna* bean supplement consisted of the full pods that contain approximately 60% grain and 40% husk (Castillo and Ayala, unpublished data). Animals were fed daily at 08:00 h, and the forage and supplement were offered separately in troughs. Daily records were made of the fresh matter offered and refused in each group of

animals and samples were taken every 14 d to quantify dry matter content of the feeds.

The weight of the animals was recorded every 14 d after a 14-h period of water and food restriction. The experiment had a completely randomized design and each treatment had five replications. The statistical analysis consisted of analysis of variance and orthogonal contrasts testing linear and quadratic effects of the level of *Mucuna* bean supplementation (Stern *et al.*, 1990).

In the last week of the experiment, the feeding behavior of the animals was recorded during a 24-h period of continuous observation. Records were taken every 30 min of the frequency of animals ruminating, eating forage and the supplement, and resting.

RESULTS AND DISCUSSION

The animals initiated intake of the *Mucuna* bean supplement quickly and by day 2, all animals in the *Mucuna* bean treatments were eating the supplement. At T5 level, the supplement was fully consumed in only 30 min. The consumption of the *Mucuna* bean supplement (grain and husks) ranged from 148 to 495 g DM a⁻¹ d⁻¹ (Table 1).

Mucuna supplementation induced weight gain in all groups except in treatment group T5 where a slight loss of weight was observed. This loss may have been due to the fact that the requirements of energy and protein were not fully met by the diet. In contrast, average daily growth in T10 and T15 was 32 and 60 g a⁻¹ d⁻¹, respectively (Table 1).

Table 1. Intake (g DM a⁻¹d⁻¹), weight gain (g a⁻¹d⁻¹) and feed conversion ratio of growing male “Pelibuey” sheep when a basal diet of fresh chopped Napier grass was supplemented with different levels of *Mucuna* bean meal.

Parameter	Treatment				SE	P-value		
	Control	Level of <i>Mucuna</i> bean				A	B	C
		T5	T10	T15				
Napier grass intake	356.2 a	438.4 b	419.6 b	400.4 b	23.2	0.02	0.250	0.990
Supplement intake	278.2	148.2	309.0	495.0	4.2	0.001	0.001	0.018
Total intake	634.4	586.6	728.6	895.4	24.0	0.001	0.001	0.018
Weight gain	44.0	- 3.4	31.8	60.4	11.8	0.010	0.050	0.100
Feed ratio conversion	14.4	-	22.91	14.8	-	-	-	-

Mucuna bean supplementation levels: T5 = 5g kg⁻¹ LW, T10= 10 g kg⁻¹ LW, T15 = 15 g kg⁻¹ LW

A = Contrast of control *vs* *Mucuna* bean supplementation, B= Linear effect of level of *Mucuna* bean supplementation,

C= Quadratic effect of level of *Mucuna* supplementation, SE=Standard Error.

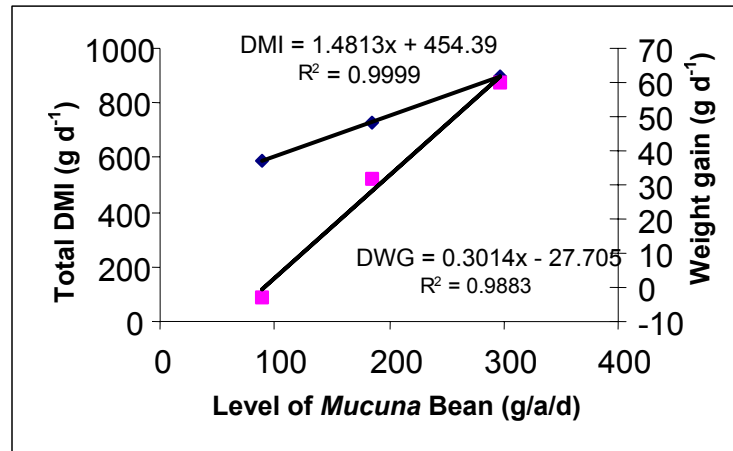


Figure 1. Dry matter intake and daily weight gain of growing male Pelibuey sheep when a basal diet of fresh chopped Napier grass was supplemented with *Mucuna* bean meal at different levels.

This growth response confirms that benefits can be obtained with the increased intake of nutrients and that intake of anti-nutrients is not negatively affecting growth (Figure 1). This result agrees with the early 20th-century report of Templeton and Gibbens (1917) where *Mucuna* bean meal was compared to cottonseed meal and it was concluded that supplementation with *Mucuna* bean was more economical. Similarly, Eilittä and Sollenberger (2002), in their review of the early 20th century literature, mention that researchers generally concluded that feeding *Mucuna* bean at 40% to 50% level to dairy cows improved both milk production and milk fat content.

Interestingly, the animals supplemented with the commercial supplemented consumed less Napier grass ($P=0.02$). There was a tendency for the animals to consume more Napier grass at lower levels of *Mucuna* supplement, presumably because the animals tried to achieve their nutrient requirements; however, the quality of forage was not enough to satisfy requirements for growth.

Mucuna bean stimulated a higher consumption of total dry matter ($DMI=454.39+1.48X$; $R^2=0.99$; Figure 1), presumably because the supplementation with protein influenced the rumen environment. There was a linear weight gain with supplementation from T5 to T15 ($LGW=-27.705+0.301X$; $R^2=0.988$; Figure 1) and the relation between LWG and feed intake was similar between the control and T15. Animals in T5 lost weight, while weight gain in T15 group was high (Table1), presumably due to the good nutritional

quality of *Mucuna* bean. Work conducted in Yucatan has shown that *Mucuna* bean grain and husk have crude protein content of 27 and 4.4%, respectively (Ayala-Burgos *et al.*, this volume). *Mucuna* bean also has high values of phosphorus and potassium (Castillo, unpublished data). Clearly, *Mucuna* bean can replace commercial feeds as live weight gains in T15 group were higher than those in the control group.

It has been shown that both grain and husk have high values of ruminal degradation (Ayala-Burgos *et al.*, this volume), suggesting a potentially high consumption. This was, indeed, the case in this experiment as the animals ate all *Mucuna* bean offered. The forage was of low quality, with abundant dry material to stimulate the feeding conditions in smallholder farms where *Mucuna* bean would likely be used to supplement forage.

In the experimental period, animals behaved normally and no detrimental impacts were associated with the *Mucuna* bean consumption. In general, feeding and resting behavior were very close to those of the control group (Figure 2). However, animals in T15 and control groups showed a slight tendency for low frequency of rumination, probably due to the low total ingestion of fiber. The normal behavior in ruminants eating high quantity of *Mucuna* bean (42 to 55 %) is in accordance with the observations of the early 20th-century researchers regarding dairy cattle, as reviewed by Eilittä and Sollenberger (2002). In this experiment none of the animals rejected *Mucuna* bean supplementation.

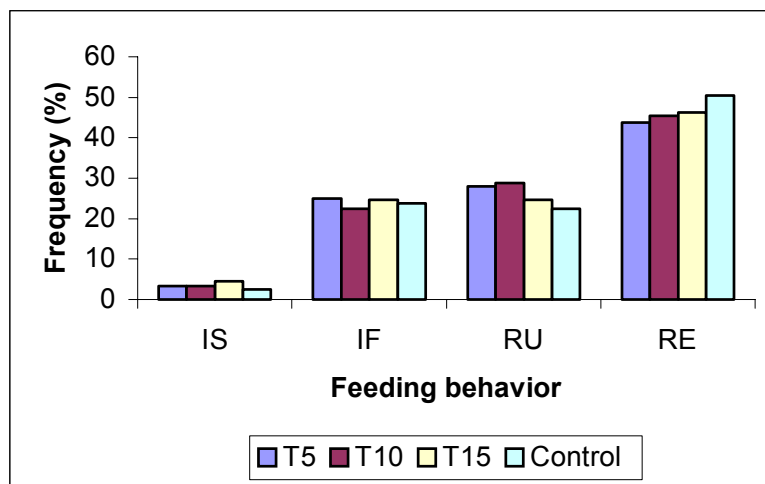


Figure 2. Supplement intake (IS), forage intake (IF) and time spent in rumination (RU) and resting (RE) of growing male Pelibuey sheep when a basal diet of fresh chopped Napier grass was supplemented with *Mucuna* bean meal at different levels.

CONCLUSIONS

We conclude that the supplementation with *Mucuna* bean from 5 to 15 g kg⁻¹ LW in growing Pelibuey lambs incremented dry matter consumption and live weight gain linearly. The behavior of the sheep was normal and no abnormal signs were associated with *Mucuna* bean consumption.

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